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Key to Large Lepidopterous Larvae on New Foliage of Douglas-fir and True Firs

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Presents a key primarily for field use, emphasizing characters visible with a hand lens. The key separates larvae of associates of the western spruce budworm, *Choristoneura occidentalis* Freeman, in advanced instars.

Keywords: Lepidoptera, larvae, *Choristoneura occidentalis*, *Pseudotsuga menziesii*, *Abies* spp.

Field workers involved in surveys or related activities on western spruce budworm often collect and count large larvae on expanding or expanded new foliage of host trees. Other foliage-feeding Lepidoptera occur on the new foliage, and it is important to be able to separate and distinguish between the various species.

This key is the second prepared by the authors for trial use by survey, control, and research personnel working on western spruce budworm. The previous one (Carolin and Stevens 1979) dealt with small larvae in opening buds and new shoots of Douglas-fir and true firs. Both keys are based primarily on notes prepared by the senior author during field studies on spruce budworm in Oregon and Washington during the period 1955-1962. This key to larger larvae includes new material from the Southwest, and experience has shown it is useful throughout the range of western spruce budworm. Also provided (table 1), is a summary of hosts and western distribution of included species.

This key is meant for larvae exceeding 10-12 mm in length; the features used in it can easily be seen with a 10X hand lens. Coloration and markings on the head, prothoracic shield, and the dorsal surface in general are particularly useful in recognition of these larger larvae. Size and shape are easier to define than in the smaller larvae found in opening buds and new shoots. A few species retain a generally similar appearance through-

out the larval stage, but most develop new and often striking characteristics as they approach larval maturity. Hence the need for a second key.

As with the previous key, only lepidopterous larvae are included. Hymenopterous species noted in the introduction to the first key change little during development, but are easier to recognize because of their larger size. Some sawfly larvae in the genus *Neodiprion* which feed in colonies on older foliage (only one species of *Neodiprion*, still unidentified, is known from new foliage) wander as they approach maturity and may be found on the new foliage. They can be recognized by the number of abdominal prolegs, body wrinkles, and shape of the head. Figure 1 compares a typical lepidopterous larva and a *Neodiprion* sawfly larva, and also shows major characteristics used in the key.

The users of a larval key often have difficulty recognizing a variety of patterns of longitudinal lines and stripes. The markings are sometimes more striking than can be adequately described. Figure 2 illustrates several of these. Together with larval size and shape, recognition of these patterns simplifies separation of these particular species.

We solicit additions to the key and comments about it. Additions should be in the form of authoritatively identified adults reared from larvae, the characteristics of which have been duly recorded during the rearing process. The junior author will arrange for determination of specimens not previously identified.

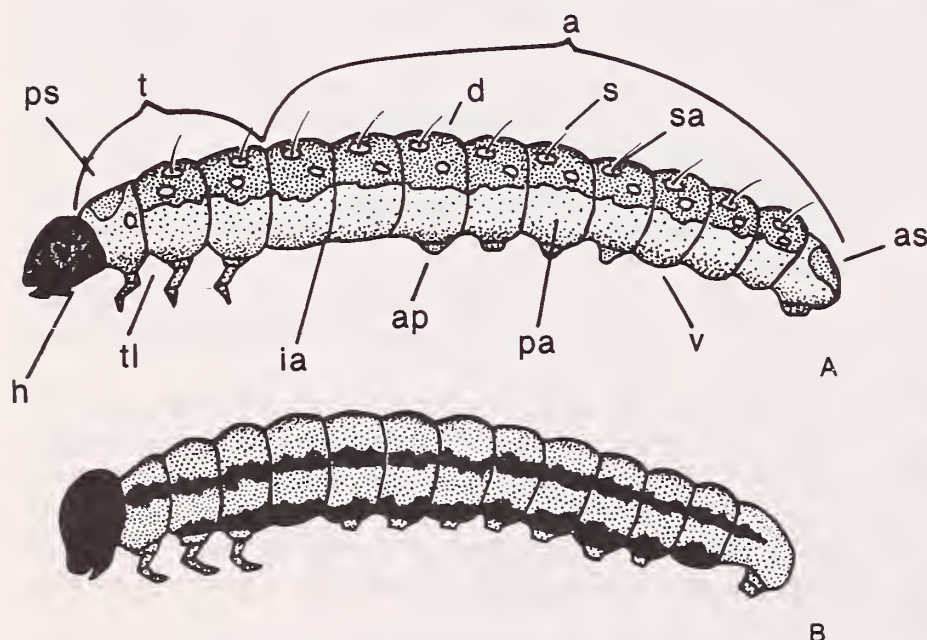
At the end of a trial period, we will revise the keys and add illustrations that will help users in picking out diagnostic characters. We hope the product will be of general utility to workers concerned with insects feeding on the new foliage of Douglas-fir and true firs.

¹Carolin, now retired, was an entomologist with the Pacific Northwest Forest and Range Experiment Station, Portland, Oreg. Stevens is an entomologist with the Rocky Mountain Forest and Range Experiment Station, in Fort Collins, in cooperation with Colorado State University.

Table 1.—Summary of species contained in key to large lepidopterous larvae on new foliage of Douglas-fir and true firs

Family	Species	Western distribution
Geometridae	<i>Enypia griseata</i> Grossbeck	Southwest
	<i>Enypia</i> sp. nr. <i>griseata</i> Grossbeck	Pacific slope ¹
	<i>Eupithecia annulata</i> (Hulst)	Pacific slope, northern Rocky Mountains
	<i>Eupithecia catalinata</i> McDunnough	Southwest
	<i>Lambdina fiscellaria lugubrosa</i> (Hulst)	Pacific slope, northern Rocky Mountains
	<i>Melanolophia imitata</i> (Walker)	Pacific slope
	<i>Nepytia phantasmaria</i> (Strecker)	Pacific slope
	<i>Stenoporpia</i> sp.	Pacific slope
Gelechiidae	Unidentified species	Pacific slope
Noctuidae	<i>Achytonix epipaschia</i> (Grote)	Pacific slope, Southwest
	<i>Feralia deceptiva</i> McDunnough	Pacific slope
	<i>Xylomyges simplex</i> (Walker)	Pacific slope, Southwest
Plutellidae	<i>Ypsolophus nella</i> (Busck)	Southwest
Pyrilidae	<i>Dioryctria reniculelloides</i> Mutuura and Munroe	Pacific slope, northern Rocky Mountains
Tortricidae Olethreutinae	<i>Griselda radicana</i> (Heinrich)	Pacific slope, Rocky Mountains, Southwest
	<i>Zeiraphera hesperiana</i> Mutuura and Freeman	Pacific slope, Southwest
Tortricinae	<i>Acleris gloverana</i> (Walsingham)	Pacific slope, northern Rocky Mountains
	<i>Archips</i> sp.	Pacific slope
	<i>Argyrotaenia dorsalana</i> (Dyar)	Pacific slope, Southwest
	<i>Argyrotaenia klotsi</i> Obraztsov	Southwest
	<i>Argyrotaenia provana</i> (Kearfott)	Pacific slope, Southwest
	<i>Choristoneura occidentalis</i> Freeman	Pacific slope, Rocky Mountains, Southwest
	<i>Choristoneura retiniana</i> (Walsingham) = <i>viridis</i> Freeman	Pacific slope
	<i>Choristoneura</i> n. sp.	Pacific slope

¹Used here to include the area west of the Continental Divide between British Columbia and northern California.



LEGEND

a	abdomen	ps	prothoracic shield
ap	abdominal proleg	s	seta
as	anal shield	sa	setal area
d	dorsum	t	thorax
h	head	tl	thoracic leg
ia	intersegmental area	v	venter
pa	pleural area		

Figure 1.—Comparison of: (A) typical lepidopterous larva, and (B) a hymenopterous larva in the sawfly genus *Neodiprion*. (3.5X)

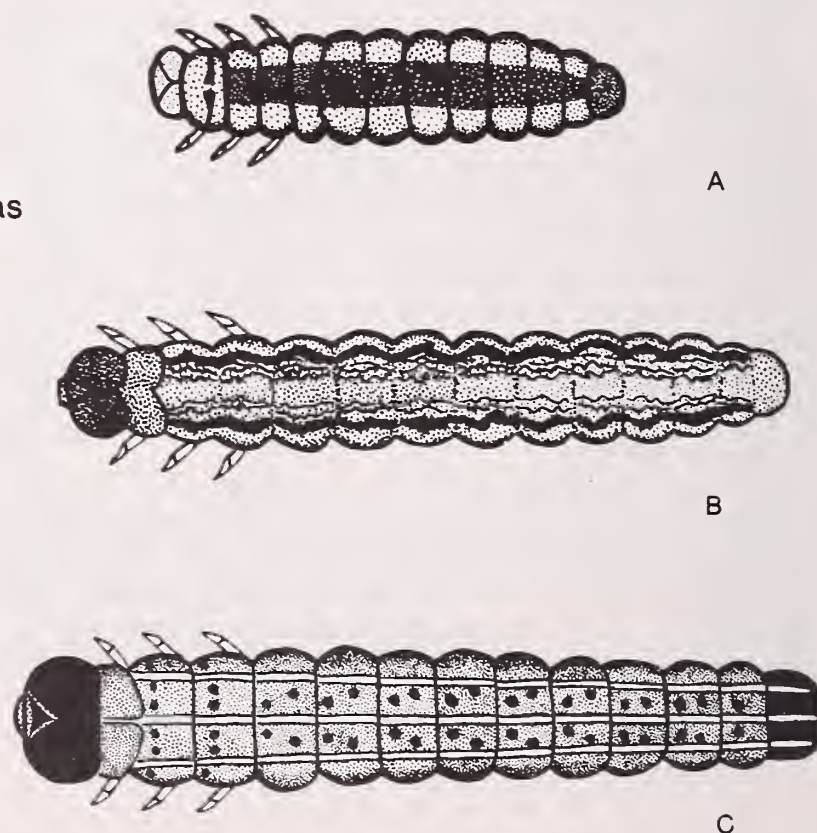


Figure 2.—Examples of longitudinal dorsal markings: (A) central stripe (*Zeiraphera hesperiana*); (B) irregular lines (*Dioryctria reniculelloides*); (C) regular lines (*Xylomyges simplex*). (3.5X)

Key to Large Lepidopterous Larvae on New Foliage of Douglas-fir and True Firs

- A. Larvae with two pairs of false legs, moving with an inching or looping motion based on use of anal prolegs Section I. Geometridae
- B. Larvae with five pairs of false legs, moving at a constant pace, but often wiggling violently when disturbed Section II. Tortricidae,² Gelechiidae, Plutellidae, Pyralidae, and Noctuidae.

Section I. Geometridae

- 1. Dorsum marked with longitudinal lines or stripes ... 4
- 1. Dorsum without longitudinal lines or stripes; pleural areas with longitudinal lines or stripes 2
 - 2. Head light brown, unicolorous; dorsum orange-red-brown; pleural areas with yellow lateral stripe; venter yellow; body length 25-35 mm *Stenoporpia* sp.
 - 2. Head whitish but mottled with light brown, black dots visible above; dorsum variously colored, with setal areas appearing as four black dots on each segment; pleural area with thick dark brown line, often divided, and with four or five thin wavy lines below it; species earlier found on new shoots but at these stages feeding on old foliage 3
- 3. Head with brown streaking as well as mottling, four black dots visible above; dorsum pale orange-brown, or pale green with orange-brown in intersegmental areas; body length 12-20 mm 4th instar *Lambdina fiscellaria lugubrosa*
- 3. Head uniformly mottled with 10 black dots visible above; dorsum light yellow-brown to gray-brown, with orange-brown on prothorax and in intersegmental areas; body length 18-30 mm 5th instar *Lambdina fiscellaria lugubrosa*
 - 4. Head orange-red; dorsum orange-red with three longitudinal purple lines; body length 10-14 mm *Eupithecia* spp.
 - 4. Head green or yellow-brown; dorsum with two longitudinal whitish lines; pleural areas with whitish lines 5
- 5. Head pale yellow-brown; dorsum light bluish green with wide whitish yellow lines; pleural areas with two whitish yellow lines, one wide and one narrow; body length 16-25 mm. Inland forests *Enypia* spp.
- 5. Head green; dorsum apple green to dark green with white lines; pleural areas with a single yellow line or stripe. Coastal forests. 6
 - 6. Head green with no markings; body length 20-37 mm; feeds mostly on old foliage *Melanolophia imitata*
 - 6. Head green with 10 black dots; body length 20-28 mm *Nepytia phantasmaria*

Section II. Tortricidae,² Gelechiidae, Plutellidae, Pyralidae, and Noctuidae

- 1. Dorsum prominently marked with longitudinal lines or stripes 11
- 1. Dorsum not prominently marked with longitudinal lines or stripes; pleural areas and venter often a lighter color 2
 - 2. Head, prothoracic shield, and remainder of body emerald green; prothoracic shield collar-like; setal areas and anal shield inconspicuous; body form slender, length 12-18 mm *Argyrotaenia provana*
 - 2. Head and prothoracic shield colored otherwise; body form stout or moderately stout, except for *Argyrotaenia dorsalana* 3
- 3. Head and prothoracic shield yellow-brown, light brown, or chestnut brown 5
- 3. Head, prothoracic shield, and outside of thoracic legs jet black; setal areas inconspicuous 4
 - 4. Body yellow-green to green; prothoracic shield sometimes pale in front; body length 10-14 mm penultimate instar *Acleris gloverana*
 - 4. Body lemon yellow; prothoracic shield solid black; body form terete and stout; body length 12-16 mm *Archips* sp.
- 5. Head pale brown to chestnut brown with no dark markings above; prothoracic shield various; setal areas various 7
- 5. Head chestnut brown with two dark triangles on each side, dorsally; prothoracic shield dark brown to black; setal areas conspicuous 6
 - 6. Dorsum olive brown to dark brown, with prominent ivory setal areas; pleural areas and venter pale yellow to light tan; body length 10-16 mm 5th instar *Choristoneura occidentalis*
 - 6. Dorsum lime green with olive tinge, with pale yellow setal areas; pleural areas and venter usually greenish but sometimes yellowish; body length 9-15 mm 5th instar *Choristoneura retiniana* (= *viridis*)
- 7. Head mostly light brown, but with two-toned appearance from greenish color around labrum or dark streak on lower part of head; prothoracic shield indistinct, concolorous with body; body pale green with small yellowish setal areas and with yellow in intersegmental areas; body form slender, length 10-14 mm *Argyrotaenia dorsalana*
- 7. Head brownish, unicolorous; prothoracic shield distinct, different color than body; body stout, length greater than 14 mm 8
 - 8. Body reddish brown to olive brown above, with large ivory setal areas and large anal shield; head and prothoracic shield orange-brown to chestnut brown 10
 - 8. Body grass green, with small or moderately large pale setal areas; head usually a lighter brown; prothoracic shield a different color than head 9
- 9. Head yellow-brown at start of stadium, later becoming chestnut brown; prothoracic shield pale brown to transparent, but marked with a thick black line at

²Includes Olethreutidae as a subfamily, Olethreutinae, per revised checklist of North American lepidoptera (Hodges et al., 1981).

- rear of shield; setal areas pale but conspicuous at start of stadium, later becoming inconspicuous; body length 12-16 mm
last instar *Acleris gloverana*
9. Head light tan; prothoracic shield pale yellow-brown with two black dots at base on each side of split in shield; setal areas pale yellow and conspicuous; anal shield oblong-orbicular, pale yellow; body length 16-22 mm
last instar *Choristoneura retiniana* (= *viridis*)
10. Larger larvae; setal areas oblong; anal shield oblong-orbicular, ivory to pale yellow; body length 17-28 mm
last instar *Choristoneura occidentalis*
10. Smaller larvae; setal areas round; anal shield round, ivory to light brown; dorsum occasionally with two very fine white lines; colors brighter than in *occidentalis*; body length 12-18 mm
last two instars *Choristoneura* n. sp.
11. Dorsum various shades of yellow, orange, red, or brown, marked with either lines or stripes 17
11. Dorsum various shades of green, sometimes with brownish tint; marked with white or brown longitudinal lines 12
12. Dorsum marked with white longitudinal lines ... 13
12. Dorsum marked with three broad longitudinal brown lines; head brown; prothoracic shield green; body length 12-18 mm
 *Argyrotaenia klotsi*
13. Dorsum with five white longitudinal lines, the lowermost ones bordered by a lateral red line; head light greenish brown; body length 30-37 mm
 *Feralia deceptiva*
13. Dorsum with three white longitudinal lines; head various colors 14
14. Head black, globose, and wider than body; prothoracic shield very pale; body light green to olive, setal areas large and black 16
14. Head green to brown, no wider than body; prothoracic shield either invisible or pale brown; body apple green, setal areas small and black 15
15. Head green, narrower than body; body bright green, sometimes with blue tinge, setal areas inconspicuous; wide longitudinal lines extended over prothorax and anal segment; body length 10-17 mm
 penultimate instar *Achytonix epipaschia*
15. Head brown, as wide as body; body pale green, setal areas conspicuous; central longitudinal line extended over prothoracic shield, and all three lines extended over brown anal segment; body length 18-22 mm last instar *Achytonix epipaschia*
16. Anal shield very pale; dorsum olive (brownish green), setal areas scarcely raised; body length 10-14 mm *Xylomyges simplex*
16. Anal shield dark brown, occupying whole segment; dorsum a mottled green, setal areas large and raised; body length 15-30 mm
 last two instars *Xylomyges simplex*
17. Large white eyespot around lateral seta on 8th ab-

- dominal segment; two irregular (undulating) white lines running through dorsocentral setae; head and prothoracic shield light brown 21
17. No eyespot on 8th abdominal segment; longitudinal lines or stripes with essentially even margins 18
18. Body form stout; head wider than long; head and prothoracic shield orange brown to chestnut brown, the latter usually margined at the rear with a black line; dorsum pale yellow to orange yellow, with a broad central olive brown or chocolate brown stripe; body length 12-15 mm last instar *Zeiraphera hesperiana*
18. Body form slender; head no wider than long, pale brown to chestnut brown; dorsum with longitudinal lines or thin stripes 19
19. Dorsum purplish, with two narrow and one broad yellowish green longitudinal lines on either side of the dorsal midline; setae and setal bases black and conspicuous; venter light greenish white; body length 9-12 mm. Larvae web ends of new needles together and feed inside enclosure
 *Ypsolophus nella*
19. Dorsum yellow or brown; setae and setal bases inconspicuous 20
20. Body pale yellow to bright yellow; dorsum marked with three orange-red or orange-brown light to heavy lines; body length 9-12 mm
 last instar *Griselda radicana*³
20. Body pale brown; dorsum marked with three red-lavender stripes; body length 12-14 mm
 unidentified species Gelechiidae
21. Dorsum pinkish brown or reddish brown; an irregular white line in pleural area; body length 10-15 mm
 penultimate instar *Dioryctria reniculelloides*
21. Dorsum pale yellow-orange to orange-red; one irregular chocolate brown stripe on each side of dorsum; body length 16-20 mm
 last instar *Dioryctria reniculelloides*

³*Griselda radicana* later enters a 3- to 4-week nonfeeding period in which it loses its markings and coloration, becoming a whitish nondescript larva hiding among foliage debris. Pupation follows.

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